Tool 1
Mathematics Content
Grades 9-12

CCSSM Curriculum Analysis Tool 1—Interpreting Functions in Grades 9-12

Name of Reviewer _____ School/District _____ Date _____

Name of Curriculum Materials _____ Publication Date _____ Course(s) _____

Content Coverage Rubric (Cont):
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Balance of Mathematical Understanding and Procedural Skills Rubric (Bal):
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CCSSM Standards Grades 9-12	Chapter pages	Cont N-L-M-A-H	Bal N-L-M-A-H	Notes/Explanation
Interpreting Functions (F-IF)				
Understand the concept of a function and use function notation				
1. Understand that a function from one set (called the domain) to another set (called the range) assigns to each element of the domain exactly one element of the range. If f is a function and x is an element of its domain, then $f(x)$ denotes the output of f corresponding to the input x. The graph of f is the graph of the equation $y = f(x)$.				
2. Use function notation, evaluate functions for inputs in their domains, and interpret statements that use function notation in terms of a context.				
3. Recognize that sequences are functions, sometimes defined recursively, whose domain is a subset of the integers.				
Interpret functions that arise in applications in terms of the context				
4. For a function that models a relationship between two quantities, interpret key features of graphs and tables in terms of the quantities, and sketch graphs showing key features given a verbal description of the relationship. *Key features include: intercepts; intervals where the function is increasing, decreasing, positive, or negative; relative maximums and minimums; symmetries; end behavior; and periodicity*				

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5. Relate the domain of a function to its graph and, where applicable, to the quantitative relationship it describes. *For example, if the function h(n) gives the number of person-hours it takes to assemble n engines in a factory, then the positive integers would be an appropriate domain for the function.*				
6. Calculate and interpret the average rate of change of a function (presented symbolically or as a table) over a specified interval. Estimate the rate of change from a graph.				
Analyze functions using different representations				
7. Graph functions expressed symbolically and show key features of the graph, by hand in simple cases and using technology for more complicated cases.				
8. Graph linear and quadratic functions. Show intercepts, maxima, & minima.				
9. Graph square root, cube root, and piecewise-defined functions, including step functions and absolute value functions.				
10. Graph polynomial functions, identifying zeros when suitable factorizations are available, and showing end behavior.				
11. (+) Graph rational functions, identifying zeros and asymptotes when suitable factorizations are available, and showing end behavior.				
12. Graph exponential and logarithmic functions, showing intercepts and end behavior, and trigonometric functions, showing period, midline, and amplitude.				
13. Write a function defined by an expression in different but equivalent forms to reveal and explain different properties of the function.				
14. Use the process of factoring and completing the square in a quadratic function to show zeros, extreme values, and symmetry of the graph, and interpret these in terms of a context.				
15. Use the properties of exponents to interpret expressions for exponential functions.				
16. Compare properties of two functions each represented in a different way (algebraically, graphically, numerically in tables, or by verbal descriptions). *For example, given a graph of a quadratic function and an algebraic expression for another, say which has larger maximum.*				

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CCSSM Curriculum Analysis Tool 1—Reasoning with Equations and Inequalities in Grades 9-12

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Reasoning with Equations and Inequalities (A-REI)				
Understand solving equations as a process of reasoning and explain the reasoning.				
1. Explain each step in solving a simple equation as following from the equality of numbers asserted at the previous step, starting from the assumption that the original equation has a solution. Construct a viable argument to justify a solution method.				
2. Solve simple rational and radical equations in one variable, and give examples showing how extraneous solutions may arise.				
Solve equations and inequalities in one variable				
3. Solve linear equations/inequalities in one variable, including coefficients represented by letters.				
4. Solve quadratic equations in one variable.				
a. Use the method of completing the square to transform any quadratic equation in x into an equation of the form $(x - p)^2 = q$ that has the same solutions. Derive the quadratic formula.				
b. Solve quadratic equations by inspection, taking square roots, completing the square, the quadratic formula and factoring, as appropriate. Recognize when the quad. formula gives complex solutions.				

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CCSSM Standards Grades 9-12	**Chapter pages**	**Cont N-L-M-A-H**	**Bal N-L-M-A-H**	**Notes/Explanation**
Solve systems of equations				
5. Prove that, given a system of two equations in two variables, replacing one equation by the sum of that equation and a multiple of the other produces a system with the same solutions.				
6. Solve systems of linear equations exactly and approximately (e.g., with graphs), focusing on pairs of linear equations in two variables.				
7. Solve a simple system consisting of a linear equation and a quadratic equation in two variables algebraically and graphically.				
8. (+) Represent a system of linear equations as a single matrix equation in a vector variable.				
9. (+) Find the inverse of a matrix if it exists and use it to solve systems of linear equations (using technology for matrices of dimension 3 × 3 or greater).				
Represent and solve equations and inequalities graphically				
10. Understand that the graph of an equation in two variables is the set of all its solutions plotted in the coordinate plane, often forming a curve (which could be a line).				
11. Explain why the x-coordinates of the points where the graphs of the equations $y = f(x)$ and $y = g(x)$ intersect are the solutions of the equation $f(x) = g(x)$; find the solutions approximately, e.g., using technology to graph the functions, make tables of values, or find successive approximations. Include cases where $f(x)$ and/or $g(x)$ are linear, polynomial, rational, absolute value, exponential, and logarithmic functions.				
12. Graph the solutions to a linear inequality in two variables as a halfplane (excluding the boundary in the case of a strict inequality), and graph the solution set to a system of linear inequalities in two variables as the intersection of the corresponding half-planes.				

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CCSSM Curriculum Analysis Tool 1— Geometric Measurement and Dimension; Modeling with Geometry in Grades 9-12

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CCSS Standards Grades 9-12	Chapter pages	Cont N-L-M-A-H	Bal N-L-M-A-H	Notes/Examples
Geometric Measurement and Dimension (G-GMD)				
Explain volume formulas and use them to solve problems				
1. Give an informal argument for the formulas for the circumference of a circle, area of a circle, volume of a cylinder, pyramid, and cone. *Use dissection arguments, Cavalieri's principle, and informal limit arguments.*				
2. Give an informal argument using Cavalieri's principle for the formulas for the volume of a sphere and other solid figures.				
3. Use volume formulas for cylinders, pyramids, cones, and spheres to solve problems.				
Visualize relationships between two-dimensional and three-dimensional objects				
4. Identify the shapes of two-dimensional cross-sections of three-dimensional objects, and identify three-dimensional objects generated by rotations of two-dimensional objects.				
Modeling with Geometry G-MG				
Apply geometric concepts in modeling situations				
1. Use geometric shapes, their measures, and their properties to describe objects (e.g., modeling a tree trunk or a human torso as a cylinder).				
2. Apply concepts of density based on area and volume in modeling situations (e.g., persons per square mile, BTUs per cubic foot).				
3. Apply geometric methods to solve design problems (e.g., designing an object or structure to satisfy physical constraints or minimize cost; working with typographic grid systems based on ratios).				

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CCSSM Curriculum Analysis Tool 1—Interpreting Categorical and Quantitative Data in Grades 9-12

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CCSSM Standards Grades 9-12	Chapter pages	Cont N-L-M-A-H	Bal N-L-M-A-H	Notes/Examples
Interpreting Categorical and Quantitative Data (S-ID)				
Summarize, represent, and interpret data on a single count or measurement variable				
1. Represent data with plots on the real number line (dot plots, histograms, and box plots).				
2. Use statistics appropriate to the shape of the data distribution to compare center (median, mean) and spread (interquartile range, standard deviation) of two or more different data sets.				
3. Interpret differences in shape, center, and spread in the context of the data sets, accounting for possible effects of extreme data points (outliers).				
4. Use the mean and standard deviation of a data set to fit it to a normal distribution and to estimate population percentages. Recognize that there are data sets for which such a procedure is not appropriate. Use calculators, spreadsheets, and tables to estimate areas under the normal curve.				

CCSSM Curriculum Analysis Tool 1—Interpreting Categorical and Quantitative Data in Grades 9-12				
Summarize, represent, and interpret data on two categorical and quantitative variables	**Chapter pages**	**Cont N-L-M-A-H**	**Bal N-L-M-A-H**	**Notes/Explanation**
5. Summarize categorical data for two categories in two-way frequency tables. Interpret relative frequencies in the context of the data (including joint, marginal, and conditional relative frequencies). Recognize possible associations and trends in the data.				
6. Represent data on two quantitative variables on a scatter plot, and describe how the variables are related.				
a. Fit a function to the data; use functions fitted to data to solve problems in the context of the data. Use given functions or choose a function suggested by the context. Emphasize linear, quadratic, and exponential models.				
b. Informally assess the fit of a function by plotting and analyzing residuals.				
c. Fit a linear function for a scatter plot that suggests a linear association.				
Interpret linear models				
7. Interpret the slope (rate of change) and the intercept (constant term) of a linear model in the context of the data.				
8. Compute (using technology) and interpret the correlation coefficient of a linear fit.				
8. Distinguish between correlation and causation.				

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Balance between Mathematical Understanding and Procedural Skills

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CCSSM Curriculum Analysis Tool 1—Similarity, Right Triangles, and Trigonometry & Trigonometric Functions in Grades 9-12

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Similarity, Right Triangles, and Trigonometry (G-SRT)				
Understand similarity in terms of similarity transformations				
1. Verify experimentally the properties of dilations given by a center and a scale factor:				
a. A dilation takes a line not passing through the center of the dilation to a parallel line, and leaves a line passing through the center unchanged.				
b. The dilation of a line segment is longer or shorter in the ratio given by the scale factor.				
2. Given two figures, use the definition of similarity in terms of similarity transformations to decide if they are similar; explain using similarity transformations the meaning of similarity for triangles as the equality of all corresponding pairs of angles and the proportionality of all corresponding pairs of sides.				
3. Given two figures, use the definition of similarity in terms of similarity transformations to decide if they are similar; explain using similarity transformations the meaning of similarity for triangles as the equality of all corresponding pairs of angles and the proportionality of all corresponding pairs of sides.				
4. Use the properties of similarity transformations to establish the AA criterion for two triangles to be similar.				
5. Prove theorems about similar triangles.				

CCSS Curriculum Analysis Tool 1—Similarity, Right Triangles, and Trigonometry & Trigonometric Functions in Grades 9-12				
CCSSM Standards Grades 9-12	**Chapter pages**	**Cont N-L-M-A-H**	**Bal N-L-M-A-H**	**Notes/Explanation**
Define trigonometric ratios and solve problems involving right triangles				
1. Understand that by similarity, side ratios in right triangles are properties of the angles in the triangle, leading to definitions of trigonometric ratios for acute angles.				
2. Explain and use the relationship between the sine and cosine of complementary angles.				
3. Use trigonometric ratios and the Pythagorean Theorem to solve right triangles in applied problems.				
Apply trigonometry to general triangles				
1. (+) Derive the formula $A = 1/2\ ab\ \sin(C)$ for the area of a triangle by drawing an auxiliary line from a vertex perpendicular to the opposite side.				
2. (+) Prove the Laws of Sines and Cosines and use them to solve problems.				
3. (+) Understand and apply the Law of Sines and the Law of Cosines to find unknown measurements in right and non-right triangles (e.g., surveying problems, resultant forces).				
Trigonometric Functions (F-TF)				
Extend the domain of trigonometric functions using the unit circle				
1. Understand radian measure of an angle as the length of the arc on the unit circle subtended by the angle.				
2. Explain how the unit circle in the coordinate plane enables the extension of trigonometric functions to all real numbers, interpreted as radian measures of angles traversed counterclockwise around the unit circle.				
3. (+) Use special triangles to determine geometrically the values of sine, cosine, tangent for $\pi/3$, $\pi/4$ and $\pi/6$, and use the unit circle to express the values of sine, cosine, and tangent for $\pi–x$, $\pi+x$, and $2\pi–x$ in terms of their values for x, where x is any real number.				
4. (+) Use the unit circle to explain symmetry (odd and even) and periodicity of trigonometric functions.				
Model periodic phenomena with trigonometric functions				
5. Choose trigonometric functions to model periodic phenomena with specified amplitude, frequency, and midline.				
6. (+) Understand that restricting a trigonometric function to a domain on which it is always increasing or always decreasing allows its inverse to be constructed.				

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CCSSM Standards Grades 9-12	**Chapter pages**	**Cont N-L-M-A-H**	**Bal N-L-M-A-H**	**Notes/Explanation**
7. (+) Use inverse functions to solve trigonometric equations that arise in modeling contexts; evaluate the solutions using technology, and interpret them in terms of the context.				
Prove and apply trigonometric identities				
8. Prove the Pythagorean identity $\sin^2(\theta) + \cos^2(\theta) = 1$ and use it to find $\sin(\theta)$, $\cos(\theta)$, or $\tan(\theta)$ given $\sin(\theta)$, $\cos(\theta)$, or $\tan(\theta)$ and the quadrant of the angle.				
9. (+) Prove the addition and subtraction formulas for sine, cosine, and tangent and use them to solve problems.				

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